MANAGEMENT OF VERTICILLIUM WILT IN THE ABSENCE OF FUMIGATION

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Verticillium wilt, caused by *Verticillium dahliae*, affects a broad taxonomic range of host species. Although some host specificity has been documented in *V. dahliae*, most strains are capable of infecting and causing disease on most of the crops which are susceptible to Verticillium wilt. The wide host range of the pathogen coupled with its ability to produce long-lived microsclerotia has made Verticillium wilt particularly difficult to control.

Soil fumigation with a combination of methyl bromide and chloropicrin has proven to be a very effective means of controlling Verticillium wilt in high value crops. Where this practice has been used in strawberry production in California, Verticillium wilt has been virtually unknown. In the absence of soil fumigation, management of Verticillium wilt requires some combination of resistant or tolerant host varieties and cultural measures to reduce soil populations of the pathogen.

The simplest approach to management of soilborne inoculum through cultural practices is long term rotations to non-host crops. Under these circumstances, *V. dahliae* is unable to produce large numbers of microsclerotia, as it would on a systemically infected host, so inoculum levels slowly decline due to attrition. Published reports suggest that intervals as long as 5-7 years out of susceptible crops may be required to prevent significant damage to a host crop.

An alternative practice which may hasten the decline in soil populations of *V. dahliae* is the incorporation of large quantities of organic matter, as can be accomplished through cover cropping, in order to render the soil microflora more antagonistic to the activity of plant pathogens. Such an effect may result from the build-up of nonpathogenic root colonizing fungi which compete with *V. dahliae* or from more directly antagonistic effects mediated by bacteria or other microbes. A somewhat different approach is to use a cover crop which is itself inhibitory to plant pathogens. Decomposition of residue derived from various species in the genus *Brassica* has been shown to produce volatile compounds which are toxic to a broad range of fungi. Consequently, including a cruciferous crop in a rotation may provide some of the beneficial effects now obtained with chemical fumigation of the soil.

In order to evaluate the potential benefits of cultural measures in management of Verticillium wilt, a pilot experiment was established at a high elevation strawberry nursery in California. Plots were located in a field with a recent history of Verticillium wilt. The following treatments were included as individual

large plots: 1) chloropicrin at 200 pounds/acre, 2) a 50:50 mix of methyl bromide:chloropicrin at 400 pounds/acre, 3) a summer irrigated mustard crop, 4) a summer irrigated sudan grass crop, 5) solarization, and 6) a non-treated control. The sudan grass and mustard crops were grown and incorporated in 1993; the mustard plot was tarped, the sudan plot was not. The fumigated and control plots were planted to strawberries in spring of 1993. All other plots were planted to strawberries in 1994.

In plots treated with either chloropicrin or the methyl bromide:chloropicrin combination, post-fumigation soil populations of *V. dahliae* were less than 1.0 microsclerotia per gram of soil. The incidence of Verticillium wilt was 1.5% in the chloropicrin treated plot and 1.0% where the methyl bromide:chloropicrin combination was applied. For comparison, the control plot had approximately 12 microsclerotia per gram of soil and the incidence of Verticillium wilt was 57%.

In contrast to the chemical fumigants, solarization, mustard and sudan grass treatments all failed to effect any measurable reduction in the soil populations of *V. dahliae*. This is not surprising for the sudan grass treatment which is not expected to directly impact soil populations of the pathogen. However, significant reductions in plant pathogen populations following decomposition of certain cruciferous crops have been reported (e.g., Ramirez-Villapuda and Munnecke, 1987). Also, we have observed reductions of 50% in *V. dahliae* populations following incorporation of broccoli residue. The reason for the apparent lack of effect in the nursery experiment is unknown. Solarization also failed to reduce soil populations of *V. dahliae*. Whether or not any of the non-chemical treatments reduced the incidence of Verticillium wilt remains to be determined.

Future experiments will be designed to explore the factors which influence the effectiveness of mustard residue incorporation in reducing soil populations of *V. dahliae*. We are also studying the survival of *V. dahliae* in infected strawberry plants, to determine the extent to which roots and petioles contribute to the soil population of *V. dahliae*.

Ramirez-Villapuda, J. and Munnecke, D.E. 1987. Control of cabbage yellows (*Fusarium oxysporum* f. sp. *conglutinans*) by solar heating of field soils amended with dry cabbage residues.